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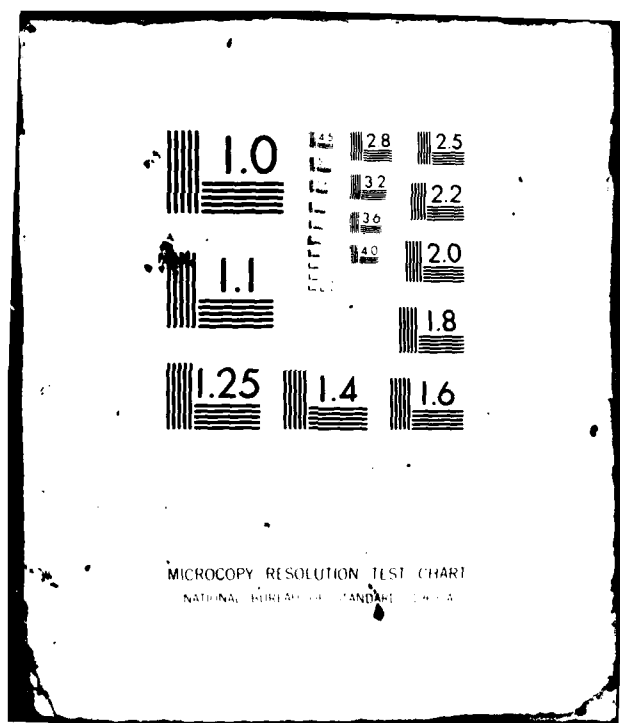
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## THESIS

AN INFORMATION SYSTEM FOR THE  
PERUVIAN AIR FORCE HOSPITAL

by

Juan Saona Nunez del Prado

June 1981

Thesis Advisor:

N. R. Lyons

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An Information System for the  
Peruvian Air Force Hospital

by

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Lieutenant Colonel, Peruvian Air Force  
B. S., Peruvian Air Force Academy, 1962

Submitted in partial fulfillment of the  
requirements for the degree of

MASTER OF SCIENCE IN INFORMATION SYSTEM


from the

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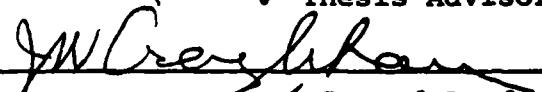
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## ABSTRACT

The purpose of this project/thesis is to define the preliminary study of a hospital information system for the Peruvian Air Force Hospital. It is written with the intention of giving to the Peruvian Air Force staff, and also to the hospital manager, an idea of the meaning of a Hospital Information System. In addition, the project/thesis describes how it would work and which would be the best system to be implemented. The last part of this project/thesis describes some of the positive and negative effects and reaction for the personnel that will be involved in this system.

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## I. INTRODUCTION

The purpose of this project/thesis is to present a preliminary study of a hospital information system for the Peruvian Air Force Hospital. With this interest, examination was made of the systems that are presently installed. Also, many articles are referenced that discuss cases of Hospital Information Systems that seemed to be relevant to this project/thesis.

In the first part of this project/thesis, the theme was focused by trying to define the meaning of a Hospital Information System, and according to the opinion of the experts in this area, the best definition was composed for the purpose of this thesis.

According to this definition of Hospital Information Systems, in the next section the different kinds of Hospital Information Systems were defined that can be structured according to the necessities or utilization of the computer that the user may have.

Using the different types of Hospital Information Systems that were described in the preceding section, writing this project/thesis was continued in an attempt to prepare a preliminary description of a Hospital Information System that can be implemented in the Peruvian Air Force Hospital.

Also, some important explanations were brought out in this section about each System in order to give a clear indication of the benefits that can be obtained by a Hospital Managers using the system.

In the last section advisement was made to the Peruvian Hospital Manager of the problems that all new Systems bring when implemented, especially with the use of a computer, and reactions of the medical personnel to the innovation of the new information system were explained.

## II. BACKGROUND

The Peruvian Air Force is one of the youngest of the Peruvian Armed Forces and in the last ten years the personnel in the Peruvian Air Force has increased by a great percentage. For this reason, one of the biggest problems that the staff of the Peruvian Air Force has is the welfare of personnel.

It is important to note that one of the goals of the staff of the Peruvian Air Force is the care of its personnel. For this reason, according to a plan that is in development, they are preparing and implementing the construction of one of the best hospitals that can be built. This new hospital will replace a small hospital which was begun in 1965 and was inaugurated in 1969.

The new hospital has a capacity of 300 beds, all of which are in use. It is important to know that this hospital is one of the most modern hospitals in Peru. According to the implementation plan it was equipped with the most sophisticated and modern technology of the time. However, there still exists one problem that can be considered an internal hospital problem. The problem is that in spite of all this modern equipment, the hospital manager may not have all the information that he needs to work with and also to make necessary decisions. Another problem that

exists is with the Inpatient and Outpatient Systems that the hospital has at this time. One reason all these problems are occurring is that this hospital does not have a computerized Hospital Information System.

It is important to know that in the Implementation Plan [Ref. 1] that was prepared by the staff of the Peruvian Air Force in 1972 it was ordered to begin planning for all the phases in which the Air Force will begin to build a big Information System in which all Units and Dependencies would be connected on-line.

In this Implementation Plan the hospital was scheduled to be on-line in 1979, but for many reasons this plan was delayed and it may not be possible to implement all, because the Peruvian Air Force is in a country that is developing and has limited economic resources to devote to the completion of the plan.

Also, it is important to note that the Peruvian Air Force has grown so large that a Hospital Information System is now urgently needed. For this reason, this project/thesis is oriented toward the purpose of conceiving and developing a Preliminary Study of a Hospital Information System for the Peruvian Air Force Hospital, which will assist the Air Force medical community by transferring the burdensome task of information retrieval from doctors, nurses, medics and hospital administrators to a data processing system.

If this is accomplished, the Peruvian Air Force Hospital will be the first with a Hospital Information System among the Peruvian Armed Force Hospitals. It would be interesting, if in the future the three main Armed Force Hospitals (Army, Navy, Air Force) could be on-line together, and using current technology, constantly improve the quality of medical care.

### III. THE HOSPITAL INFORMATION SYSTEM

#### A. DEFINITION OF HOSPITAL INFORMATION SYSTEM

There are many definitions of the term "Hospital Information system". For example, Hommer H. Schmitz said in his book of Hospital Information System that:

"The management information system supporting the operational control function are not nearly so effective, in the sense that there is not even general agreement on what such a system should do. This is due in part to the fact that management information systems in the health care field have not acclimated themselves to the various characteristics needed to accomplish this managerial function properly. In general this facet of the process is now known as the "Hospital Information System." [Ref. 2]

Also, Doctors George A. Bekey and Morton D. Schwartz say in their book that:

"A Hospital Information System is defined as a highspeed, computer-controlled, multistation authorized access information flow network for the hospital. It has business office and patient care subsystems and its function is to speed and simplify administrative and medical information handling. The Hospital Information System interfaces with the Hospital staff through the use of data terminals located at the nurses stations and at strategic points in the department and services areas. As a result, administrative and medical personnel have instantaneous access to the electronic data bank for entry or retrieval of patient data." [Ref. 3]

Bekey and Schwartz [Ref. 3] go on to list what the Hospital Information System does:

1. Store, retrieves, routes, sorts and verifies information flow.



2. Provide patient medical histories, current medical records, statical summaries and legal records.

3. It can schedule medical tests and maintain inventory control of beds and supplies.

4. It can provide current status of meal orders and accounting/billing records.

The primary objectives of a Hospital Information System are to improve medical information handling and to provide for more effective utilization of hospital personnel, equipment, and facilities. Examples of Hospital Information Systems currently in operation that satisfy these objectives are the System at the Baptist Hospital in Beaumont, Texas, and the St. Francis Hospital in Peoria, Illinois [Ref. 2]. These Hospital Informaiton Systems are currently collecting and evaluating operational data to ascertain the cost effectiveness of Hospital Information Systems.

#### B. BENEFITS OF HOSPITAL INFORMATION SYSTEM

In the same way, Bekey and Schwartz give us some potential benefits to be derived from the Hospital Information System as follows:

1. Reduction in average length of stay through improved interdepartmental communciations and availability of up-to-date medical records.

2. Reduction in clerical workload, allowing the professional staff to devote more time to patient contact and care.

3. Provision of care-oriented, computer-generated patient reports which interrelate and correlate patient data, such as a cumulative clinical laboratory report. Such a report would present all laboratory results to data in summary format for the doctor.

4. Provision of hospital operations-oriented, computer-generated reports which indicate to administration and management the current operating statistics for the hospital. These statistics include information on accounting, budgeting financial data, bed census and occupancy data, medical records, abstracting and coding, and various medical-legal documents. [Ref. 3]

#### IV. CONFIGURATION OF HOSPITAL INFORMATION SYSTEM

##### A. THE PHILOSOPHY OF ELECTRONIC SYSTEM CONFIGURATION

According to developments in recent years in the technology of computers, various approaches to system development have emerged in the field of hospital information systems. When all of the approaches are reduced to their basic philosophies of operation, they fall generally into three categories, which, according to Homer H. Schmitz in his book, are:

1. The large monolithic system with single central processor.
2. Network using medium-size host.
3. Mini-computer networks. [Ref. 2]

##### B. CATEGORIES OF HOSPITAL INFORMATION SYSTEM

###### 1. The Large Monolithic System

The large monolithic system with one central processing unit has the philosophy of building the entire system around one large central processing unit, usually manufactured by one of the major computer companies.

The approach of using a single large central processor has been taken by some hardware manufacturers, as well as by some independent vendors using a major manufacturer's hardware.

One argument for this system is that it allows the use of a consolidated data base. This means that each piece of information is introduced into the system only once and is not repeated in other files for other subsystems, thus reducing the possibility of error, both of omission and duplication.

## 2. Network Using Medium-size Host

In the case of a network using a medium-size host the system is build around a host communication system which has as a central processing unit either a medium size main-frame or a large minicomputer.

Clinical applications are accomplished by interfacing separate clinical modules having their own central processing unit. Although it is not always the case, these clinical modules are often acquired from a vendor other than the one from whom the hospital acquired the communication system.

The system utilizing this approach usually involves the introduction of clinical modules as they are needed. Using this approach, the clinical modules can be introduced and justified by the organization as the need arises. This means that the hospital must have a comprehensive plan from the beginning of its movement into the Hospital Information System field.

### 3. Mini-computer Network

This last system is the minicomputer network. In this case there are differences in minicomputer networks, so in this sense some of the philosophical elements of the large monolithic systems as well as of the network using a medium-size host are included in this approach. The major difference in this approach is that it is made up exclusively of minicomputers or microcomputers, and the modules or elements included in the network are always mini or microcomputer based.

According to the above approach, it is necessary to consider types of networks:

- Communicating Star Network
- Distributed Star
- Distributed Network [Ref. 2]

#### a. Communication Star Network

This system looks like the network using a medium-size host, except that it uses a minicomputer host to operate the basic communication network. In addition, many of the functions are distributed to other minicomputers.

This approach makes use of special purpose minicomputers in the clinical areas. As in the case of the network using a medium-size host, selection of individual clinical modules is an option available to the organization. In this approach, the minicomputer host does

the message switching, as well as directing appropriate information to an from the various special clinical areas.

b. Distributed Star

This kind of system is much like the communicating star, except that the central minicomputer controls only other minicomputers and does not have terminals or a communicating function per se.

The philosophy of this approach, as contrasted with the communicating star network, is that it is thought to be able to handle a greater terminal load by not degrading the central minicomputer with message switching responsibilities among various terminals.

Each module performs its own functions, and switches out into the control minicomputer only when another module has a need to know the information being handled in the first module.

c. Distributed Network

This last approach represents the tree network system design. In this case, there are no specialized modules in the network, each minicomputer can do all of the functions that are performed throughout the network.

In this approach, software directs the transactions and levels the load within the system. If one minicomputer central processor fails, the system continues to function, although it continues at a lower level of effectiveness.

With this kind of approach the entire network must be designed at the origin of the system, much as the large monolithic system, is developed. One advantage is that the central processing hardware required to support the system is somewhat less expensive than the single large main frame.

Another advantage is that redundancy and back-up, resulting from the multiple minicomputer central processors, give the organization more reason to feel secure about the overall operation of the system.

V. THE HOSPITAL INFORMATION SYSTEM  
IN THE PERUVIAN AIR FORCE HOSPITAL

A. THE USE OF COMPUTER CENTER IN THE NEW SYSTEM

The Peruvian Air Force has a Borroughs B-3500 computer and will upgrade in the near future to a larger system with the capacity to support on-line terminals. When installed the system will have capability to have the Air Force Hospital on-line with the system. At that time, it will be necessary to prepare a preliminary study of how it will support the Hospital. This chapter describes a method of using the big computer to centralize the system according to the monolithic configuration explained in the preceeding chapter.

The Hospital Information System will be primarily patient oriented, drawing from the experience of hospitals that are working with Hospital Information Systems at this time. In this case, the applications encompass admitting the patient, accounting for him physically, keeping records of facilities and services provided to him, and keeping records of his medical care.

The maintenance of medical and administrative records and the preparation of periodic reports must be managed on-line in the system.



## B. CONFIGURATION OF THE HOSPITAL INFORMATION SYSTEM

To support the Peruvian Air Force Hospital, it is proposed to use the infrastructure of the main frame of the Peruvian Air Force Computer Center located in the building of the Staff of the Peruvian Air Force. The Hospital is approximately 5 miles from this computer which must be the heart of the system.

Applications will be served on-line by means of an array of video display terminals and some printers.

As in most Hospitals, according to experience, the overall data processing function will be broken down into separate tasks, as follows:

1. A major proportion of the data processing effort is patient oriented. These applications encompass admitting the patient, accounting for him physically, keeping medical records, records of his progress accumulating his charges, billing him or his third party payer, and following-up on accounts receivable. All of these functions will be performed on-line through video display terminals.

2. The maintenance of medical and administrative records and the preparation of periodic reports will be required by management, these will be performed on-line with system access via video display terminals.

3. collecting and processing data for maintenance of accounts payable, the general ledger and related financial functions, and personnel and payroll accounting demand

accuracy and fast response. The display terminals facility will provide these functions with a small amount of clerical effort and paperwork.

4. Recording usage of supplies, maintaining inventory records, and performing other tasks to support the institutional operation will be also readily accomplished on-line through the video terminals. [Ref. 4]

The computer that will be in use will provide to the system both on-line and batch services which encompass interactive patient care and administrative functions. The system will help the Hospital meet its objective of maximum patient care services at minimum cost while serving as an efficient management tool. The system on-line and batch operations will provide interactive data processing for both administrative and patient care functions. Also, the major axis of the overall data processing system will be centered on inpatient care and accounting.

It is important to note that the principal goal of many of the Hospital Information Systems functions is to improve the delivery of health care both in Inpatient and Outpatient settings through the application of the computer. These support systems will be connected in a network with the central Peruvian Air Force computer. The basic function will be to record the component transactions of the care process, to communicate and distribute orders for material, services and information, to provide information support for both

clinical and facility management decisions, to insure that all specified services have been performed, to automate tasks that are either too repetitive or too intricate to be efficiently carried out manually, and to generate and update various reports and files.

The system in the Peruvian Air Force Hospital will be patient oriented, and designed around the patient ordering process. By this it is meant that physician's orders for medications, clinical lab tests, x-ray, physical therapy, etc., will be transmitted to the proper hospital department on-line. Thus, the business office applications are a natural result of the patient care and treatment process. Following is a description of the system with its principal required components:

1. Patient System
2. Clinical Laboratory System
3. Radiology System
4. Pharmacy System
5. Financial System [Ref. 2, 3, 4]

According to this description, the system will work as indicated in the following paragraphs.

1. Patient System

This System is designed to work directly with the Inpatient and Outpatient system.

a. Inpatient System

The inpatient process begins with the admitting procedure. In this case, a terminal will be installed in the admitting office. The on-line admission and registration will produce the primary data base for the patient's stay or for outpatient services. In this station it will be necessary to have a printer associated with the terminal in order to printout the admitting data which will become the first page of the patient's chart file. At the same time, the hospital census file will be automatically updated.

The room/bed assignment will be made on-line from a displayed selection of vacancies, with codes to specify surgical, male/female, age, kind of treatment, or other criteria.

If the patient has previous records when being admitted, it will not be necessary to update all the information.

It is important to notice that the patient system must be stored on-line in the patient's master file and in other files, all of which will be accessible through the video display terminals.

Also, it is important that the system produce some kind of printed report that can be used by administrative and professional personnel.

Also, it is necessary to have the financial information updated regarding the patient and his family.

In the Peruvian Air Force there are different scales in the rates of payment for medical treatment and also for hospitalization. Thus, it is necessary to update the system at the time that the patient is admitted, in order to provide services or materials to the patient for all the departments that are involved in its treatment.

Charges for laboratory procedures, radiology therapy, drugs, etc. will be entered on-line as they are incurred.

The system also will need to maintain the billing status. In this case, such information can be displayed on the terminal to an individual who enters the proper security code and patient number.

Another action the system must perform is to enter medical information on-line from various departments. The system must be accessed by authorized personnel who require medical history data, including tests/procedures from a master tile, the data from the patient's medication profile records and items from a radiology film locator file.

#### b. Outpatient System

In this system the capability to perform registration, scheduling, accounts receivable, and medical record-keeping to support all the treatment of the patients (sponsor and family) is needed. All the data must be stored in the computer system and be easily and immediately available to help the patient.

Another important issue is to retain the history and physical examination medical records, because the main thrust of the outpatient system will be directed to developing an automated ambulatory medical record.

## 2. Clinical Laboratory System

The Clinical Laboratory System will be designed to control the input and update of laboratory and pathology services on-line through video display terminals installed in all the departments that will be involved in the system.

It is important to note that in any general hospital the clinical laboratory plays a vital role. Accordingly, results of all laboratory procedures conducted on specimens from hospitalized patients are collected by several input methods, processed, reported to the appropriate nursing stations and stored in the appropriate PCMR in the central computer facility. [Ref. 2]

### a. Laboratory System

The laboratory is unique in its relationships to patient care. It is the primary source of precise quantitative data about a patient. This characteristic of the lab has contributed to the demand for more data, as evidenced by the 15-20% annual increase in work volume in the Peruvian Air Force Hospital over the last ten years. For this reason, the system is important in the Hospital Information System and its implementation must be elaborated with special care.

This system will be designed to support order entry and inquiry from any terminal in the hospital by authorized personnel. The system must have the capability to provide diverse information, such as:

- Blood collection schedules
- Nursing station list of all patients on blood collection schedule
- Lab section master list of routine work requested for the day
- Overdue test list by lab section
- Worksheets by lab work stations. [Ref. 2]

Another important capability that must be present is that any abnormal result be flagged on printed reports. High or low limits for each test will be selected by the user. If the result is outside these limits, they will be flagged on a special report and also on another cumulative summary report.

This cumulative summary will be printed on demand for any patient. This report will be for patients who are still in the hospital and whose data will be on-line.

This part of the system must address major laboratory sections, such as:

- Blood bank
- Microbiology
- Chemistry
- Hematology

- Urinalysis
- Endocrinology
- Immunology
- Stat lab
- Surgical pathology
- Cytology
- Bone marrow
- Autopsy [Ref. 4]

b. Pathology System

The pathology section of the laboratory will require that surgical and anatomical pathology results appear on the same report as the clinical pathology results, or be optionally printed on separate reports.

3. Radiology System

This system is important because it will provide the ability to manage the radiology data in the patient records and to assist in the operation and management of the radiology department. Therefore, the system will be composed of modules that collect, store, and communicate radiology information concerning the patient.

To be used on-line, this system will need to be equipped with a video terminal and also with printers in the nursing units in order to give and receive information. In other words, it must provide for order entry, order display, and result display. Terminals also need to be



located within the Radiology Department at the Peruvian Air Force Hospital for printing requisitions, updating films history, creating charge records, logging-in patients, displaying outstanding or unfinished work to be done.

As mentioned, the system will be on-line and will provide the Peruvian Air Force Hospital with an entire radiology profile for patient management. The system data will flow following the typical radiology department sequence.

This process will start with the entry at the nursing unit of the physician's order for a radiology examination.

In the radiology department, the requisition and flash cards will be automatically printed.

Many procedures can be included on one requisition. The patient will be logged-in upon arrival in the radiology department and the patient's film history may be received.

After the technicians takes the film, the procedure will be recorded and the film history will be updated.

Patient charges will be captured at this point, or optionally, at results entry time. The results, after being dictated by the radiologist, are entered into the system through use of power-typing techniques that will greatly facilitate the process.

In this system, during the radiology cycle, inquiry may be made into the status of the order. The system will provide the capability to record as incomplete any procedure that is not performed. [Ref. 2]

#### 4. Pharmacy System

This system is one of the most delicate parts of the system because a mass of prescription data without well thought out definitions and policies required the collaborative effort of physicians, pharmacists, nurses, and hospital administrators. These concepts are of more than local interest. [Ref. 4]

In order to solve this situation this system will be designed to maintain a real-time inventory, and will also allow immediate display of the medication profile for each patient. It will also print purchase orders, and charge drugs dispensed to patients to departments.

Another important function that must be implemented is that the patient medications history be accessible for on-line study and review by the physicians and pharmacy personnel using the terminals.

It is important to note that the Pharmacy Department is subordinate to the Air Force Health Directorate (equivalent to the Bureau of Medicine and Surgery) and for this reason the system will need to provide some reports to show how they are covering the reorder level, checking inventory, charging costs to the patient, controlling drugs utilized for patients, etc.

## 5. Financial System

In the Peruvian Air Force all family treatment must be paid for by the sponsor. There are many rates for relatives according to the relatives relationship.

According to the requirement of the Peruvian Air Force Hospital, this system must be designed to operate in both on-line and batch modes to provide data input, update, and print management reports. This system will be designed with the major effort focused on patient billing.

In this system, to create the input to the accounts receivable, one will need to work with input from the patient system. When the patient is discharged, it will be necessary to print a detailed bill of all the expense incurred and all the accounts entered and receivable.

All the information received from the patient system will be classified as treatment, medicines, surgery, laboratory, statistics, and others.

Although it is policy that all the treatments for the inpatient and outpatient must be paid in cash or credit by the sponsor, it may also occur that the therapy and treatment was very expensive. In this case, the payment can be in installments, normally in three months. For this reason this system must take care of a billing/credit for each patient.

## VI. REACTIONS AGAINST A NEW SYSTEM

### A. BACKGROUND IN REACTIONS

Based of previous experience in implementing and changing a system, it may be said that in the Peruvian Air Force when the first computer was installed to work with the Supply System, many people believed that they would be replaced by the new system. They began to obstruct their duties and tried to demonstrate that the computer constantly created problems. To solve this problem one must demonstrate that they were wrong and their work will always be necessary to the Peruvian Air Force, and that with the help of the computer they will persevere and will feel more comfortable and sure with the information. For this reason, the resistance, and also, the effects that the implementation of a Hospital Information System in the Peruvian Air Force Hospital may cause will be discussed in this chapter. Also, focus will be made on this topic according to the experience of Hospital Information Systems in which significant user resistance has been encountered, such the system is El Camino Hospital in California. [Ref. 5]

### B. RESISTANCE TO INNOVATION

A discussion of only the adoption of innovation leaves as incomplete picture. Many attempts at innovation fail.

One important reason, a very reasonable one, is that the advocated innovation is simply not functional enough, that is, it does not do what it purports to do. However, there are many other reasons why innovations fail to be adopted by organizations and why they may not perform adequately once admission to the organization is achieved [Ref. 6].

Also, part of the resistance is the manner in which individuals react to their environment and the way others attempt to influence them is very much dependent on their own feeling of confidence or sense of competence. The sense of competence is defined as the cumulative result of the whole history of transactions with the environment. [Ref. 7]

The resistance can never be considered as a single entity or process but has many components. Some major features are:

- Threat to the Established Social Structure. The fact that innovation may pose a threat to the established social structure has been of particular interest to anthropologists and those concerned with bringing about change in underdeveloped countries. A general finding is that resistance is roughly proportional to the amount of change required in the social structure and the strength of the social values which are challenged.

- Threat to vested interest. When vested interests are at issue in resistance to change, resistance may be focused at a high level, where social strength and power are centered.

- Threat to the individual. Reason for individual resistance at this point is very strong, but on the other hand, this kind of resistance by the individual is likely to be strongest at the point where pressure for change is the greatest.

- Characteristics of the knowledge. In this case the knowledge may be described in terms of "unencumbered" and "encumbered" knowledge. Unencumbered knowledge is that which permits individual options in innovation, encumbered knowledge is that which required widespread acceptance by a group or social system.

- The case for resistance. It is easy to adopt a stance which implies that "change is good--resistance is bad". This is, of course, not necessarily true. Resistance may be a stubborn unwillingness to change, it may also be a carefully thought-out position. [Ref. 7]

### C. FORMS OF RESISTANCES

User resistance to an Automatic Data Processing System may appear in a variety of forms. Some typical forms of resistance are listed below, progressively from the least active to most active forms. Many have been cited by Sanders [Ref. 8] and Zaltman [Ref. 6].

- Showing lowered morale
- Complaining about the system
- Avoiding proficiency with new equipment or procedure

- Bypassing Automatic Data Processing System/keeping own manual records
- Withholding data information
- Lack of cooperation with manager or system personnel
- Slowing performance
- Absenteeism or tardiness
- Lobbying against the system
- Mistreatment of software/providing inaccurate data
- Resignation or transfer

#### D. REASONS FOR RESISTANCE

According to many studies, it has been demonstrated that there are many motivations that force one or more individuals to resist a new system. These reasons may be separated into:

- Reason for resistance during the pre-implementation period,
- Reason for resistance during the implementation period.

##### 1. Pre-implementation Period

In this period, that is, the time before the computer is installed, staff members may be expected to resist the change. For many reasons they will say that the system appears to be inferior or inappropriate. In addition, the system may also appear to the staff to be too complex for their purposes or they may perceive the implementation schedule as involving too much, too soon, too fast.

Another reason for resistance can be unacceptable concomitants. In this case, there may be many structural

factors in the organization that are sources of resistance. The principle of systemic coherence holds that it is difficult to change one part of the system without changing other parts of the system [Re.f 6]. Consequently, the computer is likely to bring with it changes in operation that are due more to reorganization than to computerization, and it may be these concomitant changes in supervision or work environment that are the true causes of staff resistance to the computer system.

In this sense, Zaltman point out in his book that pre-implementation resistance can be beneficial, saying that its existence may highlight problems in the organization and bring forth or require more detailed and careful reasoning by the proponent of the innovation.

Indirectly, the threat of resistance causes the advocates of change to plan ahead and anticipate possible negative consequences of the innovation [Ref. 6]. Based on the experiences at El Camino Hospital in California, it is interesting to note that in some cases the delay between training and initiation of an actual operation by users had an obvious detrimental effect upon user effectiveness [Ref. 5].

## 2. Implementation Period

This period occurs after the installation of the computer. Many types of resistance can exist, for example, when the performance of a new computer appears to be inferior



to the previous computer, or when the new computer is being tuned up for its future operation. In such cases, the system with highest technical quality results in a more favorable user attitude and a favorable perception of the information system and information service staff [Ref. 9].

Because of the anticipated resistance caused by the implementation and installation of a new Hospital Information System in the Peruvian Air Force Hospital, it is possible that effects from these changes may be positive or negative.

The introduction of a Hospital Information System into any hospital is associated with some negative effects. According to Barnet,

"One of the most troublesome results of more sophisticated technology is that an automated information system may be used as an excuse for incomplete or irresponsible behavior." [Ref. 10]

Based on the experiences gained from many implementations of Hospital Information Systems and the objective of this project/thesis to prepare a preliminary study of a Hospital Information System for the Peruvian Air Force Hospital, it is necessary to anticipate some of the positive and negative effects on patient care.

a. Positive Effects

Some cases of positive effects may be:

- All automation acts to produce complete and exact information of a patient clinical course and treatment.

Also, the new Hospital Information System will provide various reports described in the preceding chapter. The reports will provide information on a more frequent basis.

- Another important positive effect will be that with the help of a computerized system, such as the laboratory or radiology system described in the preceding chapter, it is possible to more quickly detect any abnormalities and display these abnormalities so that they are brought to the immediate attention of the physician.

- Also, the new system will provide good flexibility in handling increases in workload. That is, it can accommodate seasonal and daily variations in the workload with less alteration of staffing levels. This should enable the hospital staff to deal more effectively with peak workloads.

- With all the good effects above, it is possible that individuals whose jobs are most affected by these positive effects will experience a higher degree of job satisfaction with the new system.

#### b. Negative Effects

Some negative effects will also occur, especially in the implementation period. Some of those are:

- When the implementation is occurring, it will be necessary to use both manual and automated procedures in many processes. This duplication will decrease the progress of the system.

- Also, with the new implementation, some people will have reduced efficiency while they are learning the new procedure that are used in the new system.

- As always when a new system needs to be implemented, it is necessary that the staff members expect extra time and have additional responsibilities during this period. This extra time will be required to refine clerical and administrative procedures and to enter data base information into the system.

- The new system will be designed to support more patients than the manual system. For this reason it will be necessary to load more information from patients that are in the hospital and from new patients.

#### E. IMPACTS CAUSED BY HOSPITAL INFORMATION SYSTEM

When the Hospital Information System is implemented, many significant effects will result in the physician and patient areas. For this reason, it is necessary to emphasize and discuss some of these impacts. The patient administrator will have improved administrative reporting procedures and overall patient administration through more efficient information handling. Some procedures that may be affected by the implementation can be:

- Registration
- Pre-admission
- Admission

- Change in administrative status
- Patient accountability

As the objective of this project/thesis is to discuss a preliminary study of a Hospital Information System for the Peruvian Air Force Hospital, it is also necessary to alert the staff members of various facts. In the case of installing a new system in a Hospital that has never before used one, first of all there will be the intent to have a system which will aid them but also there will be some effects on some people who might not receive the system with good intentions.

In the case of a physician, he will need to change his procedure of attending the patient. In order to check the results of tests he will need to make some inquiries for these results. Another important impact is that to review the overall status of his patient, he will need the use of the terminals. This will improve his ability to control his patients. He must also be willing to learn how to use the terminal query system.

Also, the system will cause a change in awareness of daily schedules, hospital activities and available resources. In addition to processing and transmitting specific patient data, the physician can be provided with his daily schedule of appointments, notification of meetings or administrative announcements and information concerning the availability of beds, medications, etc.

On the other hand, the nurses will be as affected as much as the physicians. One of the impacts that the system will have for the nurses will be the reduction in time spent performing administrative and clerical procedures. In this case, it will be important to show that when the system is installed, it will increase the nurses capability to perform their jobs more effectively by reducing the time spent on such administrative and clerical procedures as transcribing orders, generating work schedules and summaries, and posting reports in patients' charts.

Another problem will be with continued staff orientation to manual information-retrieval procedures. This means that if only one part of the hospital is computerized and the nurses rotate assignment to other areas, then the additional problem exists, as with the physicians, of continually having to instruct nurses as to correct use of the system which is implemented.

The system may cause a change in role status of nurses relative to the physician. Because the nurses will interact with the system more frequently than physicians, they may have a better knowledge of the system's capability and be able to perform computer procedure more efficiently.

## VII. CONCLUSION

In reading this project/thesis one might reach the conclusion that automation is the solution to the information problems in the Peruvian Air Force Hospital. When the hospital information system is implemented, since the hospital is not an industrial enterprise in the true sense, the administrator must be doubly sure that the new hospital information system will provide a service that is more efficient and in a more effective method than the presently available human resource.

For this reason this project/thesis had the objective that the hospital information system will optimize the effectiveness and efficiency of all the services in the hospital, the information system is only subject to the limitations of the technology of communications. With this system, the Peruvian Air Force Hospital will be more effective in:

The flexibility of communication processes,

The elimination of a tremendous amount of paper work,

The supplying of medical records in a logical format,

The preparation and programming of events,

The reduction of errors and delays in editing orders that have been input.

For these reasons, the hospital administrator must be fully aware of the significance of automation; what it is and what it can do for his hospital. In other words, the

more knowledgeable the administrator is of what is involved in computerizing a hospital, the more likely success should result.

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